Section 8
CONSTANT PRESSURE ANALYSIS CHARTS

Weather information for computer generated constant pressure charts is observed primarily by balloon-ascending radiosonde packages. Each package consists of weather instruments and a radio transmitter. During ascent instrument data are continuously transmitted to the observation station. Radiosondes are released at selected observational sites across the USA at 00Z and 12Z. The data collected from the radiosondes are used to prepare constant pressure charts twice a day.

Constant pressure charts are prepared for selected values of pressure and present weather information at various altitudes. The standard charts prepared are the 850 mb (hPa), 700 mb (hPa), 500 mb (hPa), 300 mb (hPa), 250 mb (hPa), and 200 mb (hPa) charts. Charts with higher pressures present information at lower altitudes, and charts with lower pressures present information at higher altitudes. Table 8-1 lists the general altitude (pressure altitude) of each constant pressure chart.

PLOTTED DATA

Data from each observation station are plotted around a station circle on each constant pressure chart. The circle identifies the station position. The data plotted on each chart are temperature, temperature-dew point spread, wind, height of the surface above sea level, and height change of the surface over the previous 12-hour period. The temperature and spread are in degrees Celsius, wind direction is relative to true north, wind speed is in knots, and height and height change are in meters. The station circle is shaded black when the spread is 5 degrees or less (moist atmosphere), and open when spread is more than 5 degrees (dry atmosphere). Figure 8-1 illustrates a station model of the radiosonde data plot. Table 8-2 gives station data plot examples for each constant pressure chart.

Aircraft and satellite observations are also used as information sources for constant pressure charts. A square is used to identify an aircraft reporting position. Data plotted are the flight level of the aircraft in hundreds of feet, temperature, wind, and time to the nearest hour UTC. A star is used to identify a satellite reporting position. Satellite information is determined by identifying cloud drift and height of cloud tops. Data plotted are the flight level in hundreds of feet, time to the nearest hour UTC, and wind. Aircraft and satellite data are plotted on the constant pressure chart closest to their reporting altitudes. Aircraft and satellite information are particularly useful over sparse radiosonde data areas.

ANALYSIS

All constant pressure charts contain analyses of height and temperature variations. Also, selected charts have analyses of wind speed variations. Variations of height are analyzed by contours, variations of temperature by isotherms, and variations of wind speed by isotachs.

CONTOURS

Contours are lines of constant height, in meters, which are referenced to mean sea level. Contours are used to map the height variations of surfaces that fluctuate in altitude. They identify and characterize pressure systems on constant pressure charts.

Contours are drawn as solid lines on constant pressure charts and are identified by a three-digit code located on each contour. To determine the contour height value, affix "zero" to the end of the code. For example, a contour with a "315" code on the 700 mb/hPa chart identifies the contour value as 3,150 meters. Also, affix a "one" in front of the code on all 200 mb/hPa contours and on 250 mb/hPa contours when the code begins with zero. For example, a contour with a "044" code on a 250 mb/hPa chart identifies the contour value as 10,440 meters.

The contour interval is the height difference between analyzed contours. A standard contour interval is used for each chart. The contour intervals are 30 meters for the 850 and 700 mb (hPa) charts, 60 meters for the 500 mb (hPa) chart, and 120 meters for the 300, 250, and 200 mb (hPa) charts.

The contour gradient is the distance between analyzed contours. Contour gradients identify slopes of surfaces that fluctuate in altitude. Strong gradients are closely spaced contours and identify steep slopes. Weak gradients are widely spaced contours and identify shallow slopes.

The contour analysis displays height patterns. Common types of patterns are lows, highs, troughs, and ridges. Contours have curvature for each of these patterns. Contour patterns can be further characterized by size and intensity. Size represents the breadth of a system. Sizes can range from large to small. A large pattern is generally more than 1,000 miles across, and a small pattern is less than 1,000 miles across. Intensities can range from strong to weak. Stronger systems are depicted by contours with stronger gradients and sharper curvatures. Weaker systems are depicted by contours with weaker gradients and weaker curvatures. For example, a chart may have a large, weak high, or a small, strong low.

Contour patterns on constant pressure charts can be interpreted the same as isobar patterns on the surface chart. For example, an area of low height is the same as an area of low pressure.

Winds respond to contour patterns and gradients. Wind directions parallel contours. In the Northern Hemisphere, when looking downwind, contours with relatively lower heights are to the left and contours with relatively higher heights are to the right. Thus, winds flow counterclockwise (cyclonically) around lows and clockwise (anticyclonically) around highs. (In the Southern Hemisphere these directions are reversed.) Winds that rotate are termed circulations. Wind speeds are faster with stronger gradients and slower with weaker gradients. In mountainous areas, winds are variable on pressure charts with altitudes at or below mountain crests. Contours have the effect of "channeling" the wind.

ISOTHERMS

Isotherms are lines of constant temperature. An isotherm separates colder air from warmer air. Isotherms are used to map temperature variations over a surface.

Isotherms are drawn as bold, dashed lines on constant pressure charts. Isotherm values are identified by a two-digit block on each line. The two digits are prefaced by "+" for above-freezing values as well as the zero isotherm and "-" for below-freezing values. Isotherms are drawn at 5-degree intervals on each chart. The zero isotherm separates above-freezing and below-freezing temperatures.

Isotherm gradients identify the magnitude of temperature variations. Strong gradients are closely spaced isotherms and identify large temperature variations. Weak gradients are loosely spaced isotherms and identify small temperature variations.

ISOTACHS

Isotachs are lines of constant wind speed. Isotachs separate higher wind speeds from lower wind speeds. Isotachs are used to map wind speed variations over a surface. Isotachs are analyzed on the 300, 250, and 200 mb (hPa) charts.

Isotachs are drawn as short, fine dashed lines. Isotach values are identified by a two- or three-digit number followed by a "K" located on each line. Isotachs are drawn at 20-knot intervals and begin at 10 knots.

Isotach gradients identify the magnitude of wind speed variations. Strong gradients are closely spaced isotachs and identify large wind speed variations. Weak gradients are loosely spaced isotachs and identify small wind speed variations.

Zones of very strong winds are highlighted by hatches. Hatched and unhatched areas are alternated at 40-knot intervals beginning with 70 knots. Areas between the 70- and 110-knot isotachs are hatched. Areas between the 110- and 150-knot isotachs are unhatched. This alternating pattern is continued until the strongest winds on the chart are highlighted. Highlighted isotachs assist in the identification of jet streams.

THREE-DIMENSIONAL ASPECTS

It is important to assess weather in both the horizontal and vertical dimensions. This not only applies to clouds, precipitation, and other significant conditions, but also pressure systems and winds. The characteristics of pressure systems vary horizontally and vertically in the atmosphere.

The horizontal distribution of pressure systems is depicted by the constant pressure charts and the surface chart (Section 5.) Pressure systems appear on each pressure chart as pressure patterns. Pressure charts identify and characterize pressure systems by their location, type, size, and intensity.

The vertical distribution of pressure systems must be determined by comparing pressure patterns on vertically adjacent pressure charts. For example, compare the surface chart with the 850 mb/hPa chart, 850 mb/hPa with 700 mb/hPa, and so forth. Changes of pressure patterns with height can be in the form of position, type, size, or intensity.

The three-dimensional assessment of pressure systems infers the assessment of the three-dimensional variations of wind.

USING THE CHARTS

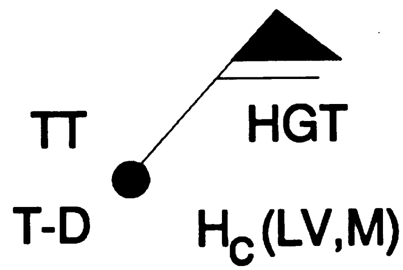
Constant pressure charts are used to provide an overview of selected observed en route flying conditions. Use all pressure charts for a general overview of conditions.

Select the chart closest to the desired flight altitude for assessment of en route conditions. Review the winds along the route. Consider their direction and speed. For high altitude flights, identify jet stream positions. Note whether pressure patterns cause significant wind shifts or speed changes. Determine if these winds will be favorable or unfavorable (tailwind, headwind, crosswind.) Consider vertically adjacent charts and determine if a higher or lower altitude would have a more desirable en route wind. Interpolate winds between charts for flights between chart levels. Review other conditions along the route. Evaluate temperatures by identifying isotherm values and patterns. Evaluate areas with moist air and cloud potential by identifying station circles shaded black.

Consider the potential for hazardous flight conditions. Evaluate the potential for icing. Freezing temperatures and visible liquid forms of moisture produce icing. Evaluate the potential for turbulence. In addition to convective conditions and strong surface winds, turbulence is also associated with wind shear and mountain waves. Wind shear occurs with strong curved flow and speed shear. Strong lows and troughs and strong isotach gradients are indicators of strong shear. Vertical wind shear can be identified by comparing winds on vertically adjacent charts. Mountain waves are caused by strong perpendicular flow across mountain crests. Use winds on the pressure charts near mountain crest level to evaluate mountain wave potential.

Pressure patterns cause and characterize much of the weather. As a general rule, lows and troughs are associated with clouds and precipitation, while highs and ridges are associated with good weather. However, this rule is more complicated when pressure patterns change with height. Compare pressure pattern features on the various pressure charts with other weather charts, such as the weather depiction and radar summary charts. Note the association of pressure patterns on each chart with the weather.

Pressure systems, winds, temperature, and moisture change with time. For example, pressure systems move, change size, and change intensity. Forecast products predict these changes. Compare observed conditions with forecast conditions and be aware of these changes.



Code	Explanation
WIND:	Plotted wind direction and speed by symbol. Direction is to the nearest 10 degrees and speed is to the nearest 5 knots. (See Figure 5-3 for the explanation of the symbols.) If the direction or speed is missing, the wind symbol is omitted and an "M" is plotted in the H_c space. If speed is less than 3 knots, the wind is light and variable, the wind symbol is omitted, and an "LV" is plotted in the H_c space.
HGT:	Plotted height of the constant pressure surface in meters above mean sea level. (See Table 8-1 for decoding.) If data is missing, nothing is plotted in this position.
TT:	Plotted temperature to the nearest whole degree Celsius. A below-zero temperature is prefaced with a minus sign. Position is left blank if data is missing. A bracketed computer-generated temperature is plotted on the 850 mb/hPa chart in mountainous regions when stations have elevations above the 850 mb/hPa pressure level. If two temperatures are plotted, one above the other, the top temperature is used in the analysis.
T-D:	Plotted temperature-dew point spread to the nearest whole degree Celsius. An "X" is plotted when the air is extremely dry. The position is left blank when the information is missing.
$H_{c:}$	Plot of constant pressure surface height change which occurred during the previous 12 hours in tens of meters. For example, a +04 means the height of the surface rose 40 meters and a -12 means the height fell by 120 meters. H_c data is superseded by "LV" or "M" when pertinent.
CIRCLE:	Identifies station position. Shaded black when T-D spread is 5 degrees or less (moist). Unshaded when spread is more than 5 degrees.

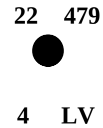
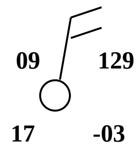
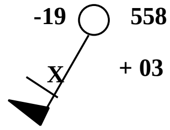
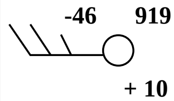
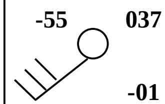
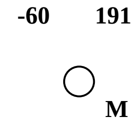
Figure 8-1. Radiosonde Data Station Plot.

Table 8-1 Features of the Constant Pressure Charts - U.S.

Pressure (millibars/hectoPascals)	Pressure Altitude in feet (flight level)	Pressure Altitude in meters	Temperature/ Dew Point Spread	Isotachs	Contour Interval (meters)	Decode Station Height Plot: Prefix to Plotted Value	Decode Station Height Plot: Suffix to Plotted Value	Examples of Station Height Plotting: Plotted	Examples of Station Height Plotting: Height
850	**5,000**	**1,500**	**yes**	**no**	**30**	**1**	___	**530**	**1,530**
700	**10,000**	**3,000**	**yes**	**no**	**30**	**2 or 3***	___	**180**	**3,180**
500	**18,000**	**5,500**	**yes**	**no**	**60**	_____	**0**	**582**	**5,820**
300	**30,000**	**9,000**	**yes****	**yes**	**120**	_____	**0**	**948**	**9,480**
250	**34,000**	**10,500**	**yes****	**yes**	**120**	**1**	**0**	**063**	**10,630**
200	**39,000**	**12,000**	**yes****	**yes**	**120**	**1**	**0**	**164**	**11,640**

NOTE:
1. The pressure altitudes are rounded to the nearest 1,000 for feet and to the nearest 500 for meters.
2. All heights are above mean sea level (MSL).
3. * Prefix a “2” or “3,” whichever brings the height closer to 3,000 meters.
4. ** Omitted when the air is too cold (temperature less than -41 degrees).

Table 8-2 Examples of Radiosonde Plotted Data

						
	850 mb	**700 mb**	**500 mb**	**300 mb**	**250 mb**	**200 mb**
WIND	**light and variable**	**010/20 KTS**	**210/60 KTS**	**270/25 KTS**	**240/30 KTS**	**missing**
TT	**22° C**	**9° C**	**-19° C**	**-46° C**	**-55° C**	**-60° C**
T-D	**4° C**	**17° C**	**>29° C**	**not plotted**	**not plotted**	**not plotted**
DEW POINT	**18° C**	**-8° C**	**dry**	**dry**	**dry**	
HGT	**1,479 m**	**3,129 m**	**5,580 m**	**9,190 m**	**10,370 m**	**11,910 m**
H_c	**not plotted**	**- 30 m**	**+ 30 m**	**+ 100 m**	**- 10 m**	**not plotted**

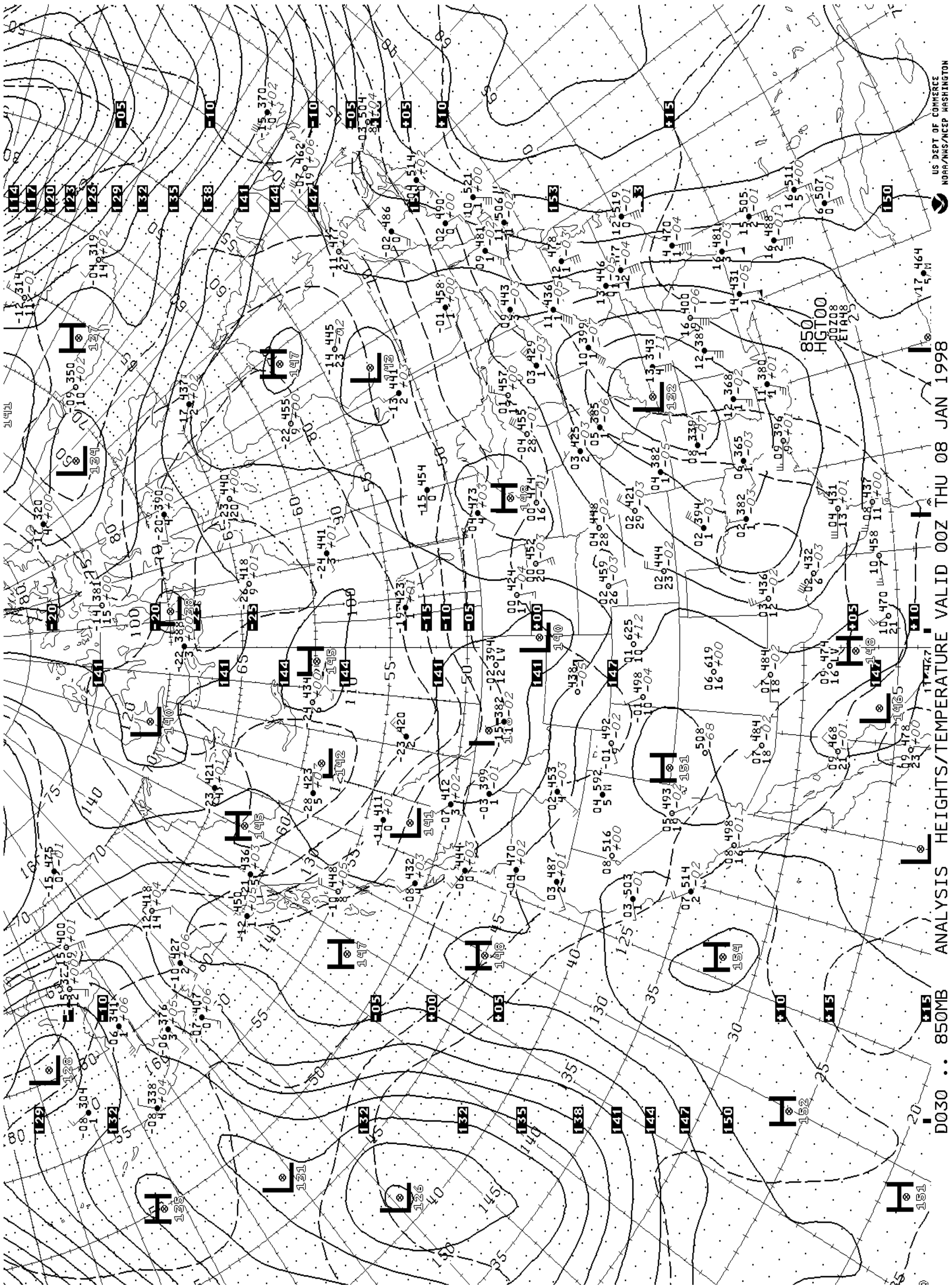


Figure 8-2. 850 Millibar/HectoPascal Analysis.

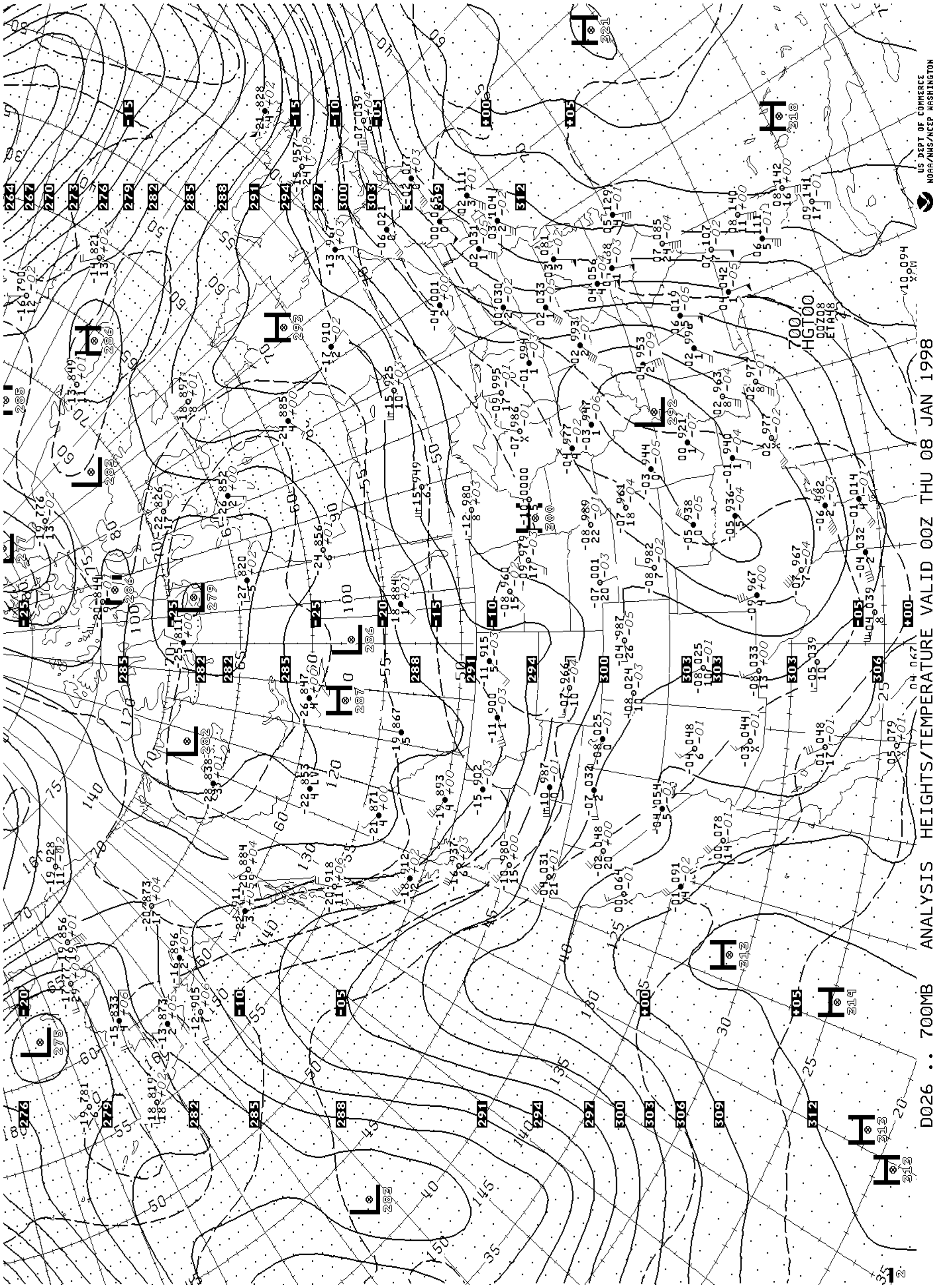


Figure 8-3. 700 Millibar/HectoPascal Analysis.

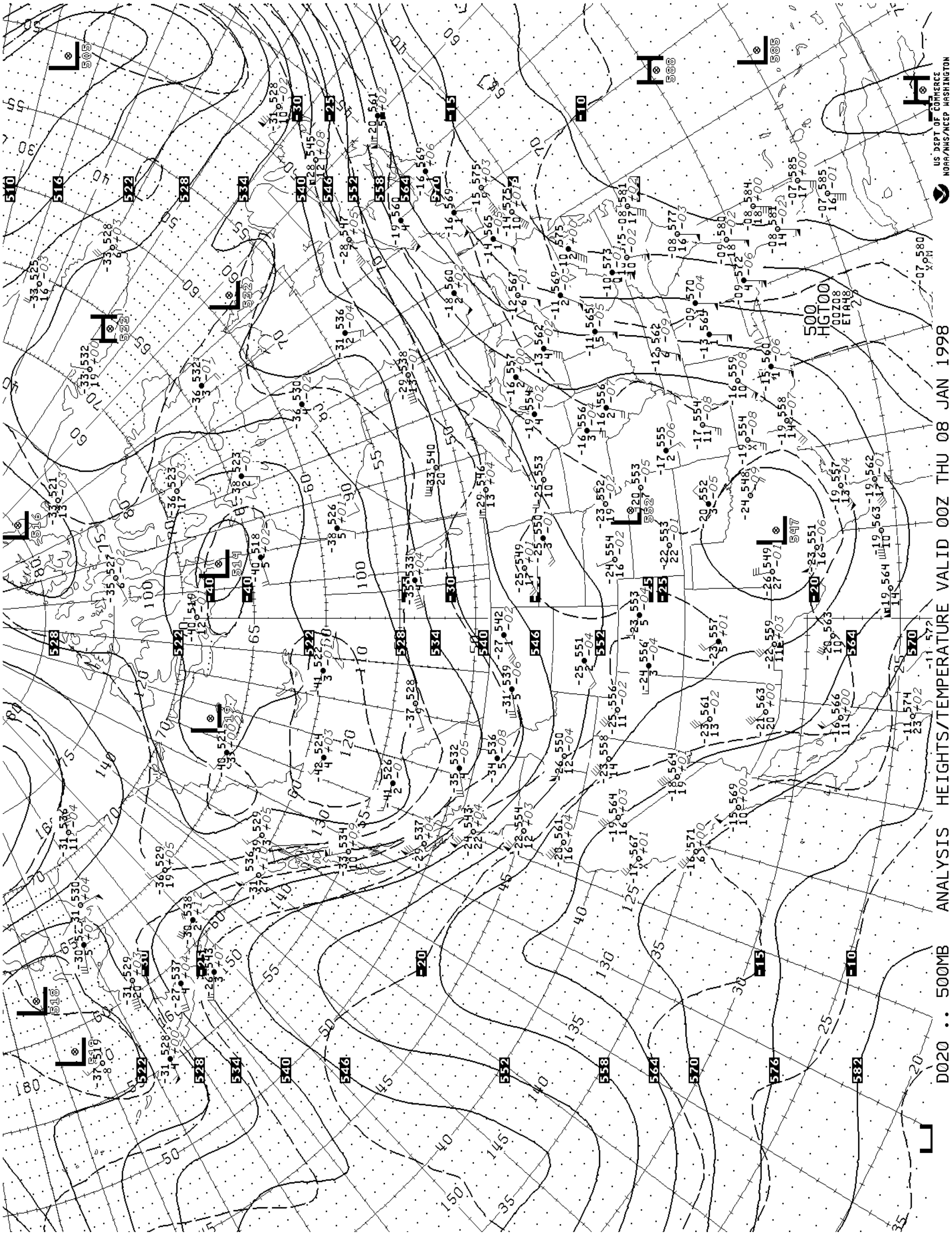


Figure 8-4. 500 Millibar/HectoPascal Analysis.

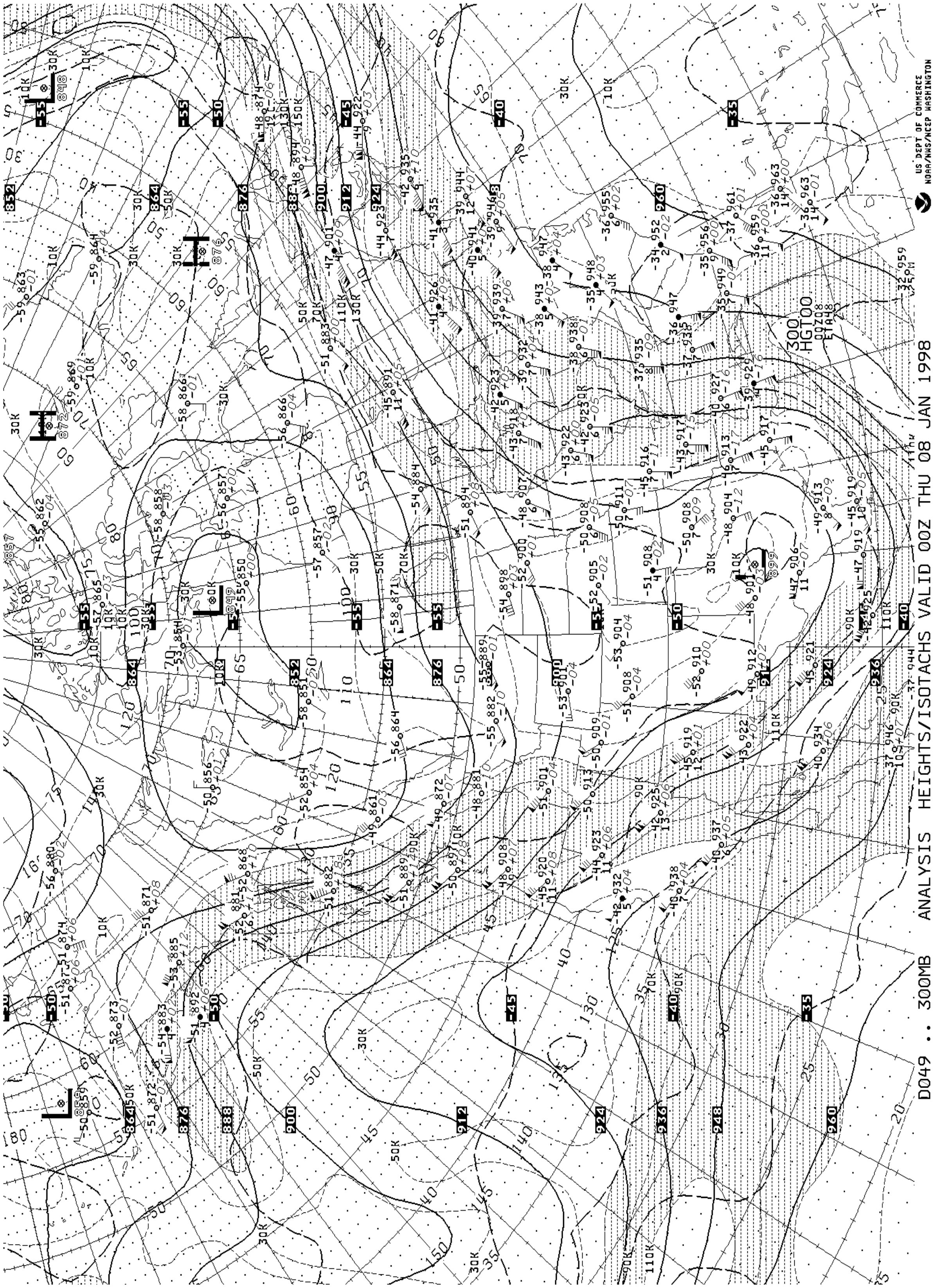


Figure 8-5. 300 Millibar/HectoPascal Analysis.

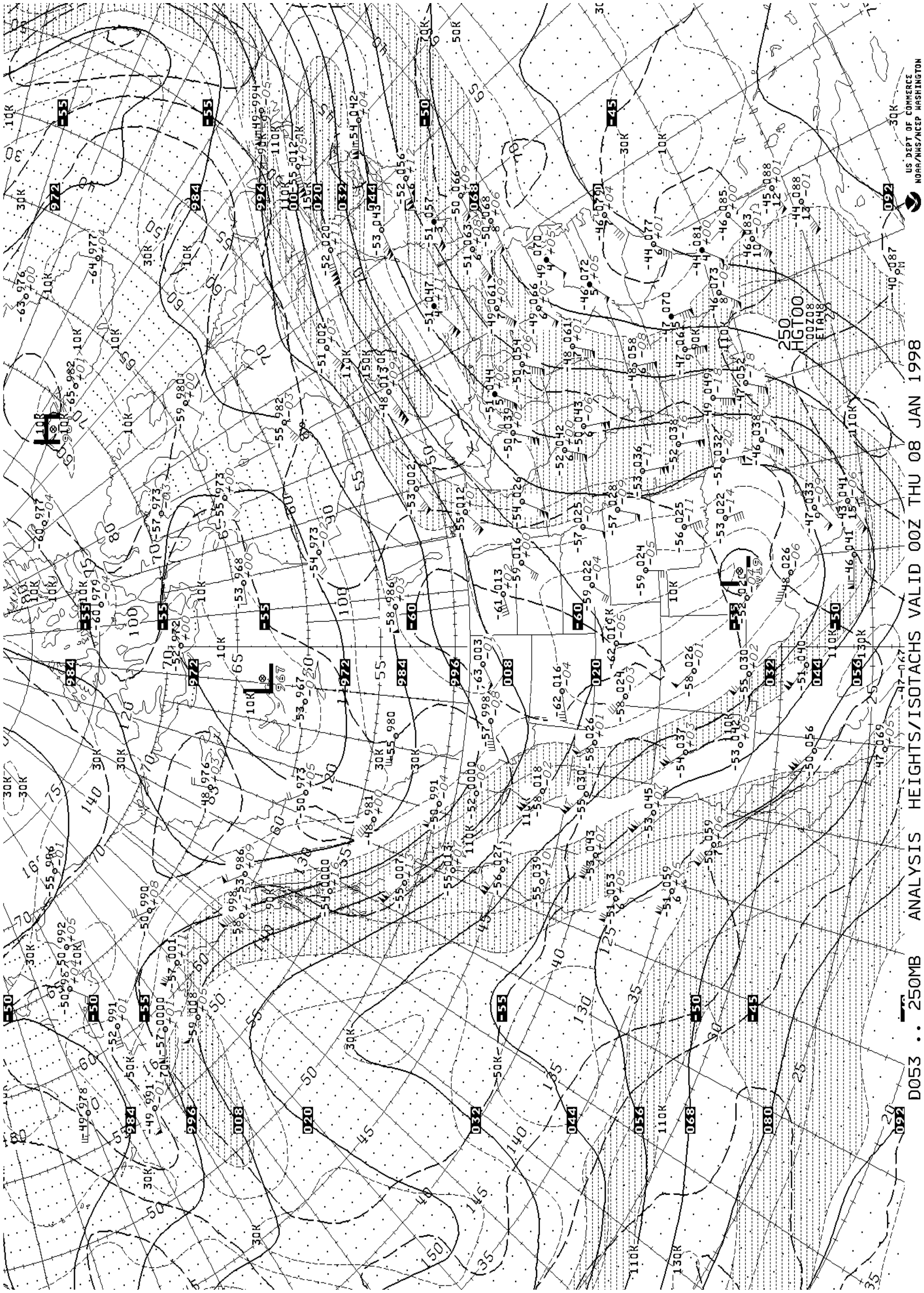


Figure 8-6. 250 Millibar/HectoPascal Analysis.